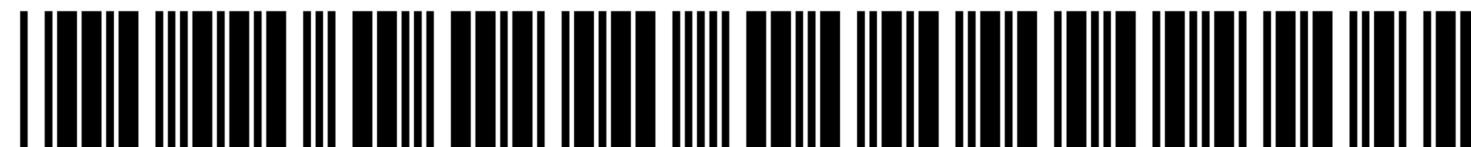

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Chou et al.

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(45) **Date of Patent: Nov. 6, 2012**

(54) **METHOD OF MANUFACTURING A MULTILAYER PRINTED CIRCUIT BOARD WITH A BUILT-IN ELECTRONIC DEVICE**

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(73) Assignee: **Unitech Printed Circuit Board Corp.**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 33 days.

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
H01K 3/10 (2006.01)

(52) **U.S. Cl.** **29/852**; 29/830; 29/846; 361/765; 361/766

(58) **Field of Classification Search** 29/825, 29/830, 840, 846, 852; 361/765, 766
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,161,093	A *	11/1992	Gorczyca et al.	361/795
6,316,732	B1 *	11/2001	Lim	174/255
7,348,662	B2 *	3/2008	Miyazaki et al.	257/679
7,957,154	B2 *	6/2011	Ito et al.	361/765
8,083,954	B2 *	12/2011	Chang et al.	216/13
2006/0203456	A1 *	9/2006	Sohn et al.	361/748
2008/0007927	A1 *	1/2008	Ito et al.	361/764

FOREIGN PATENT DOCUMENTS

TW	518616	1/2003
TW	I246383	12/2005

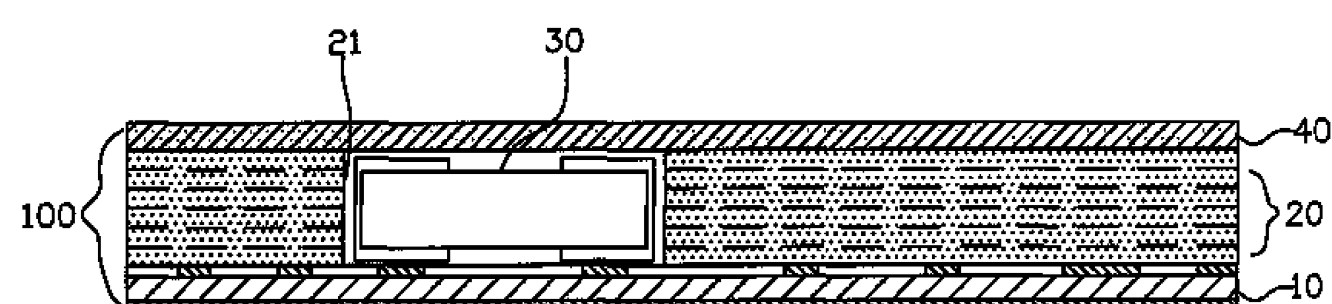
* cited by examiner

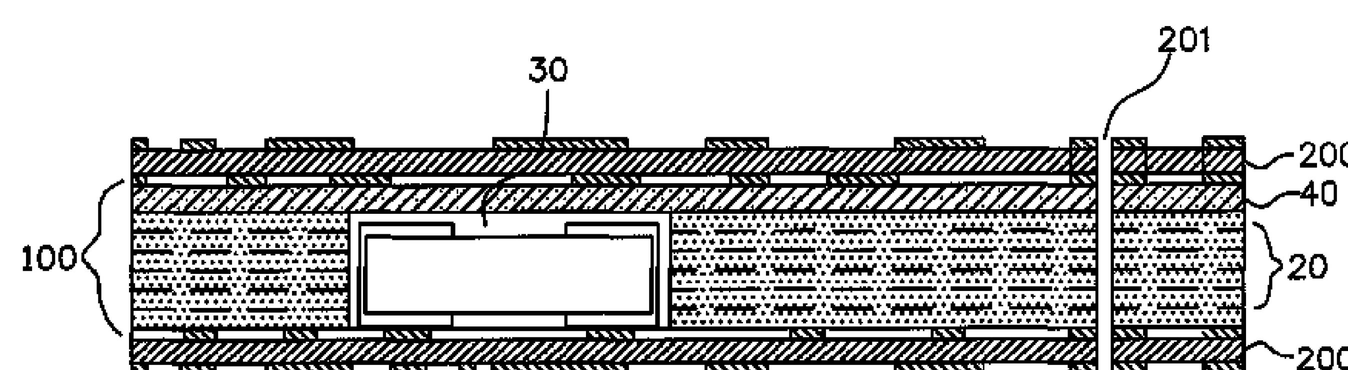
Primary Examiner — Carl Arbes
(74) *Attorney, Agent, or Firm* — Muncy, Geissler, Olds & Lowe, PLLC

(57) **ABSTRACT**

A method of manufacturing a multilayer printed circuit board of a built-in electronic device provides a substrate having a copper clad laminate and a first dielectric layer. The first dielectric layer is laminated onto the copper clad laminate and has a cavity for accommodating the electronic device. A second dielectric layer is laminated onto the substrate and electronic device to produce a base circuit board with an embedded electronic device. A build-up circuit layer is formed on the base circuit board. The first and second dielectric layers are made of a plastic material.

15 Claims, 9 Drawing Sheets





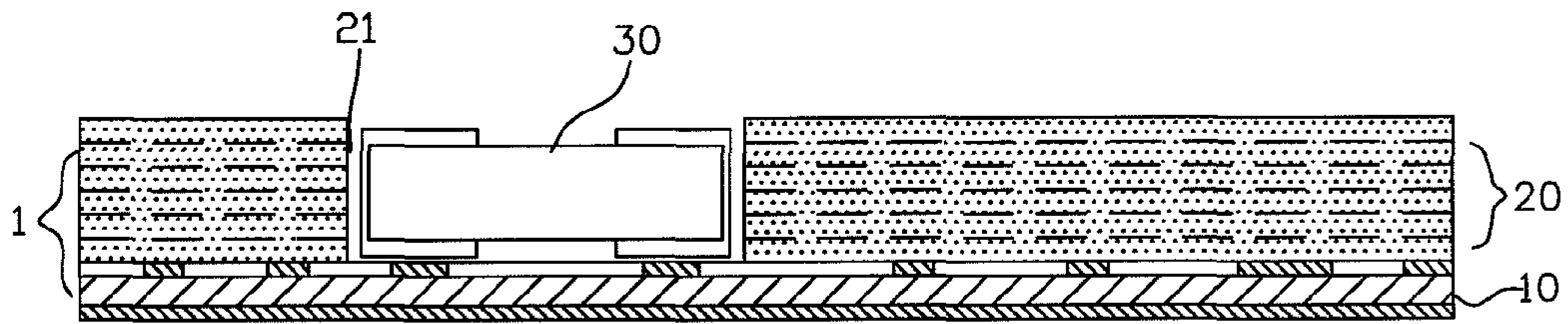


Fig. 1a

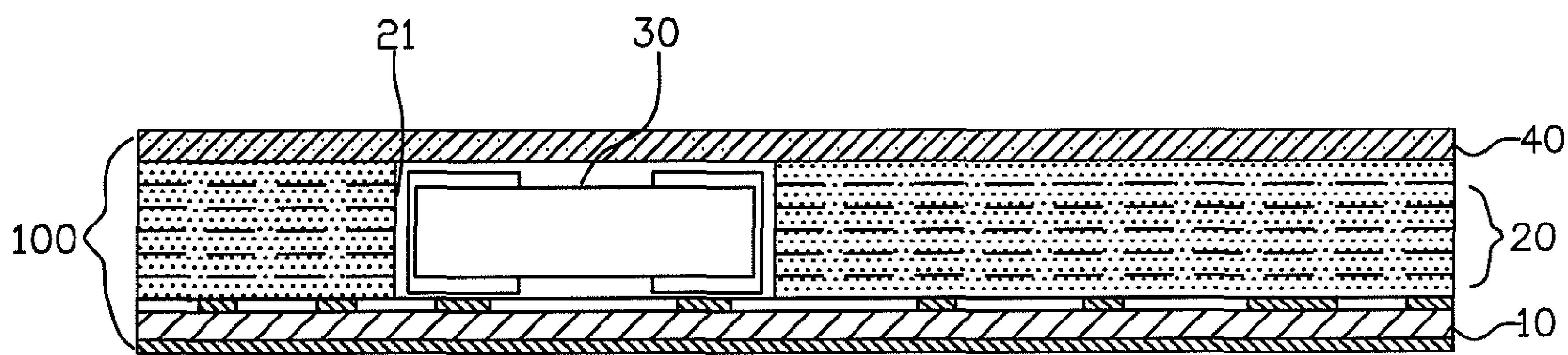


Fig. 1b

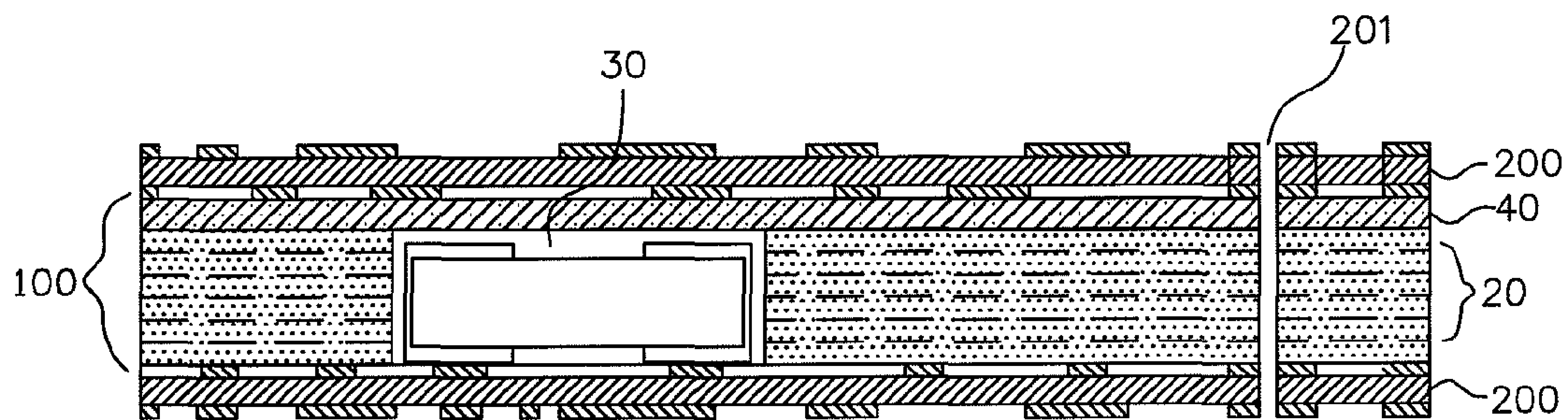


Fig. 1c

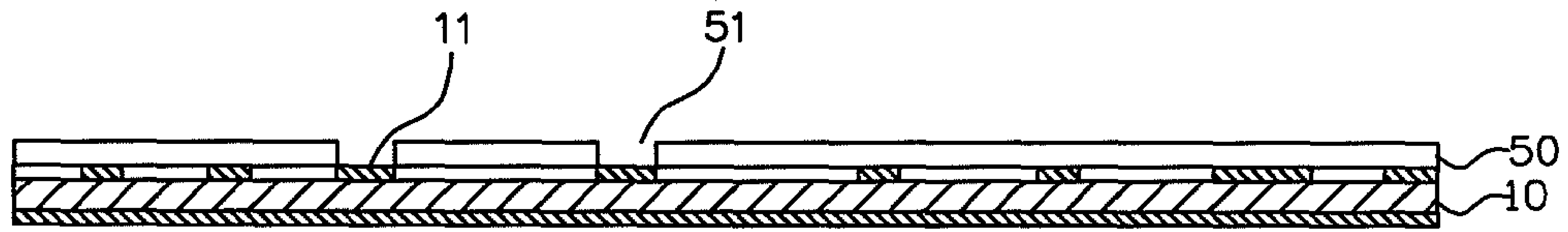


Fig. 2a

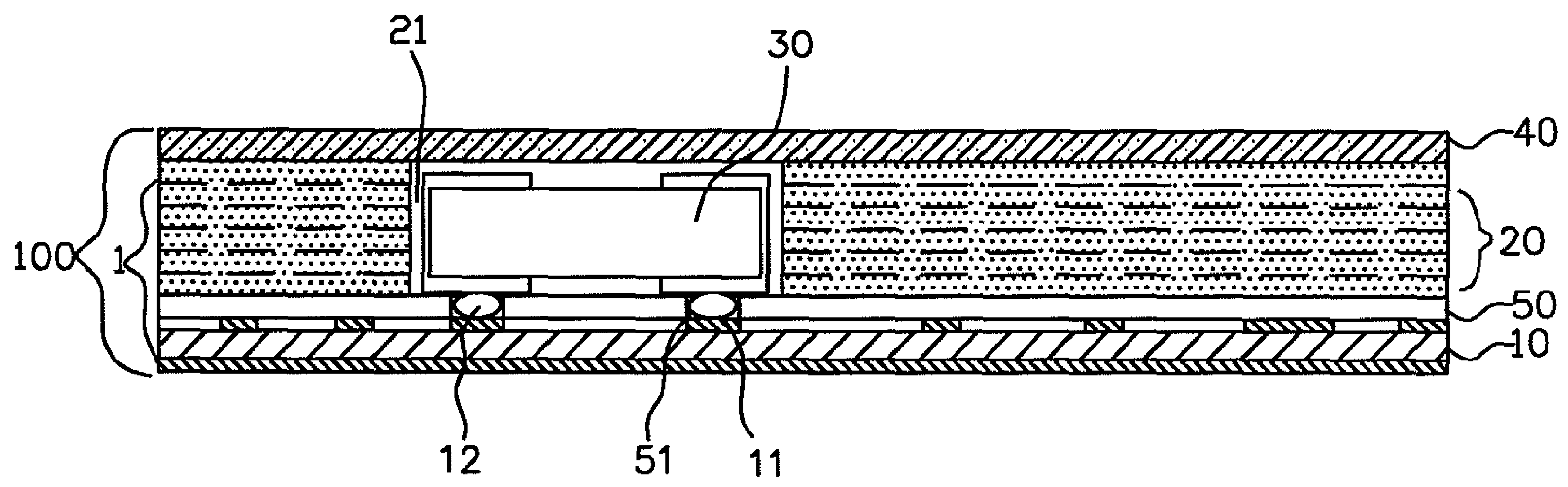


Fig. 2b

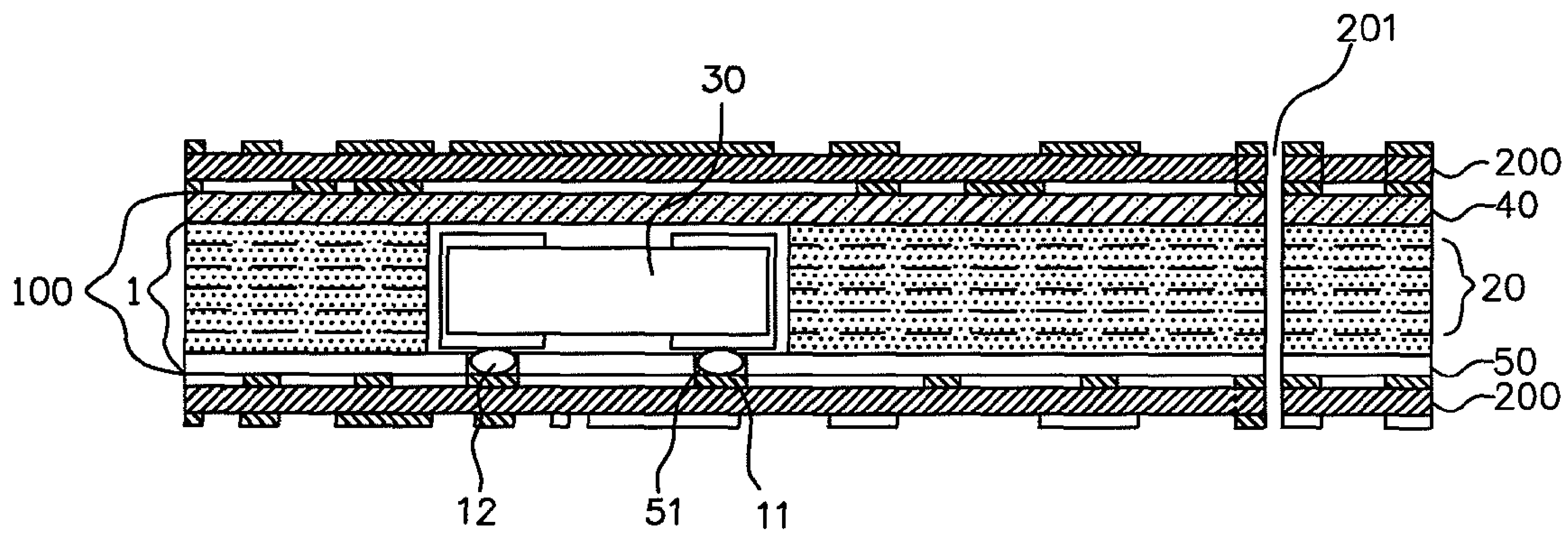


Fig. 2c

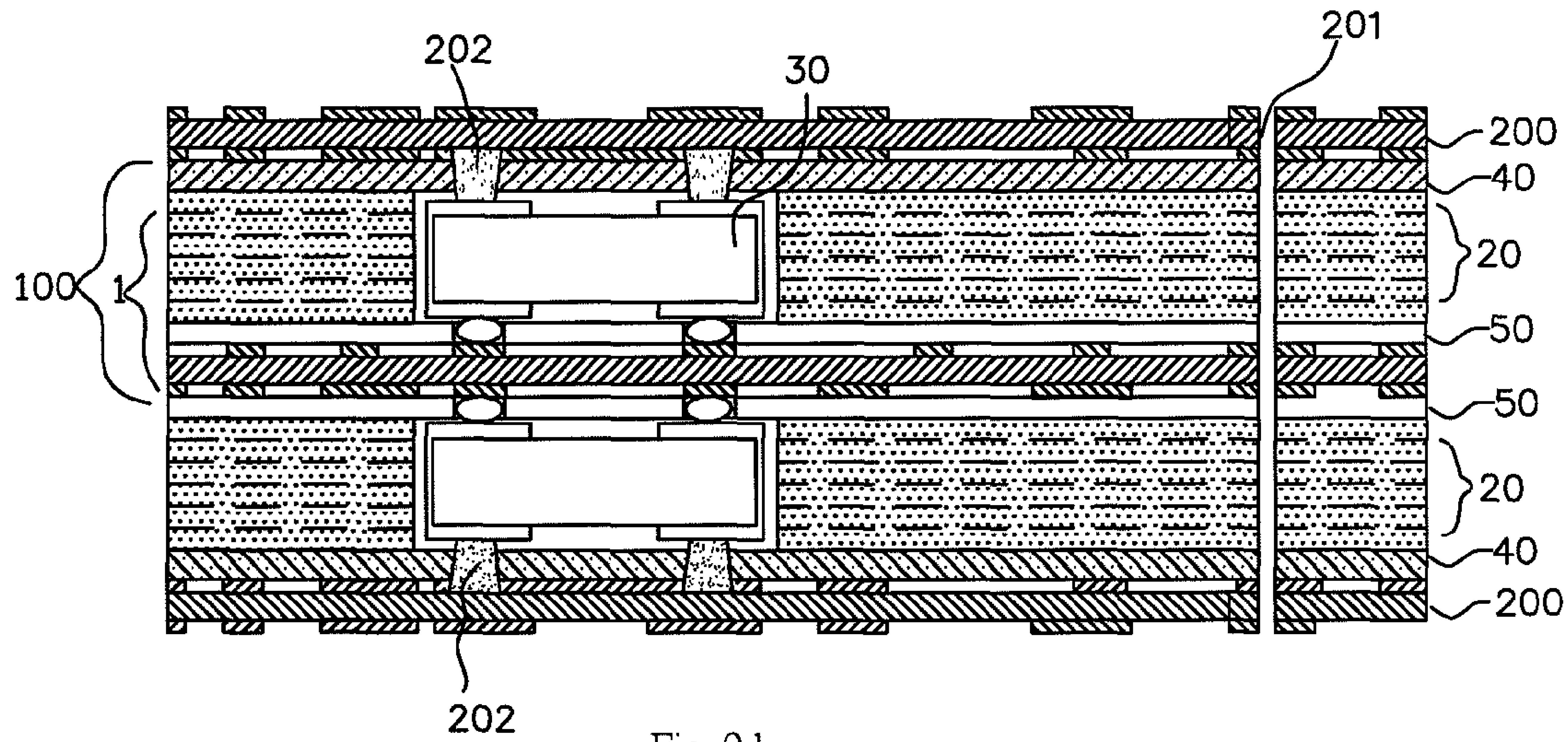


Fig. 2d

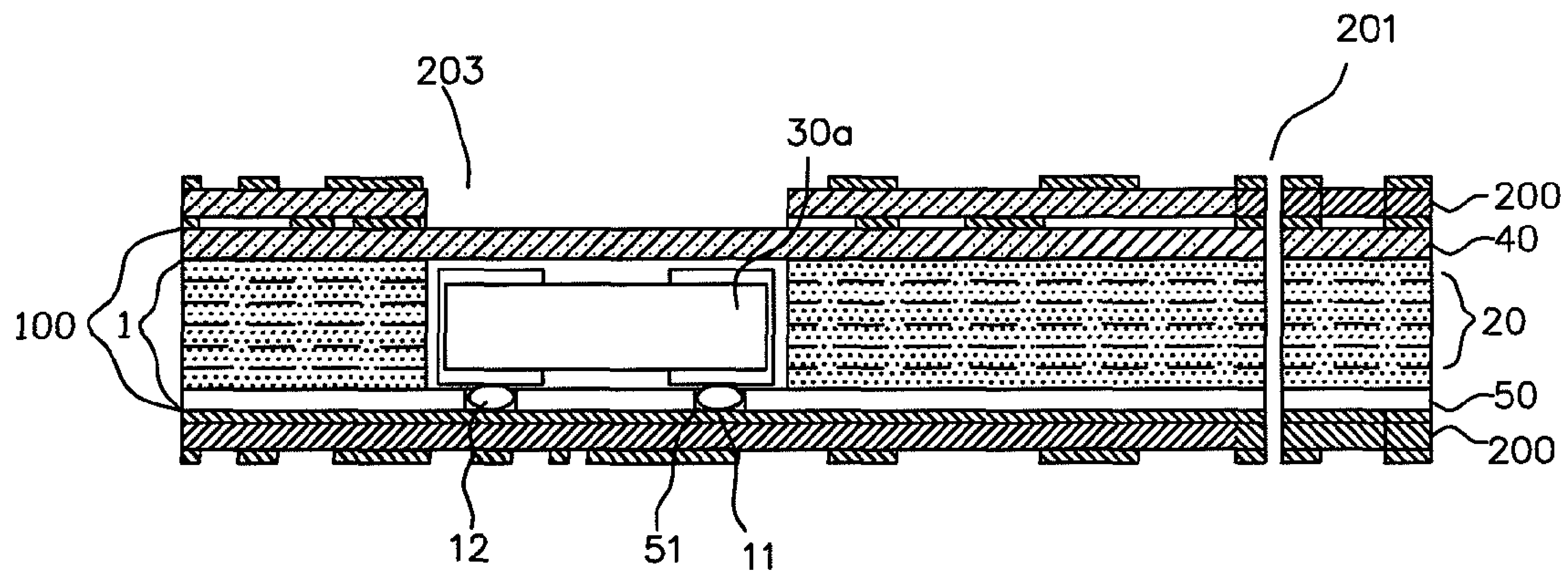


Fig. 2e

Fig. 3a

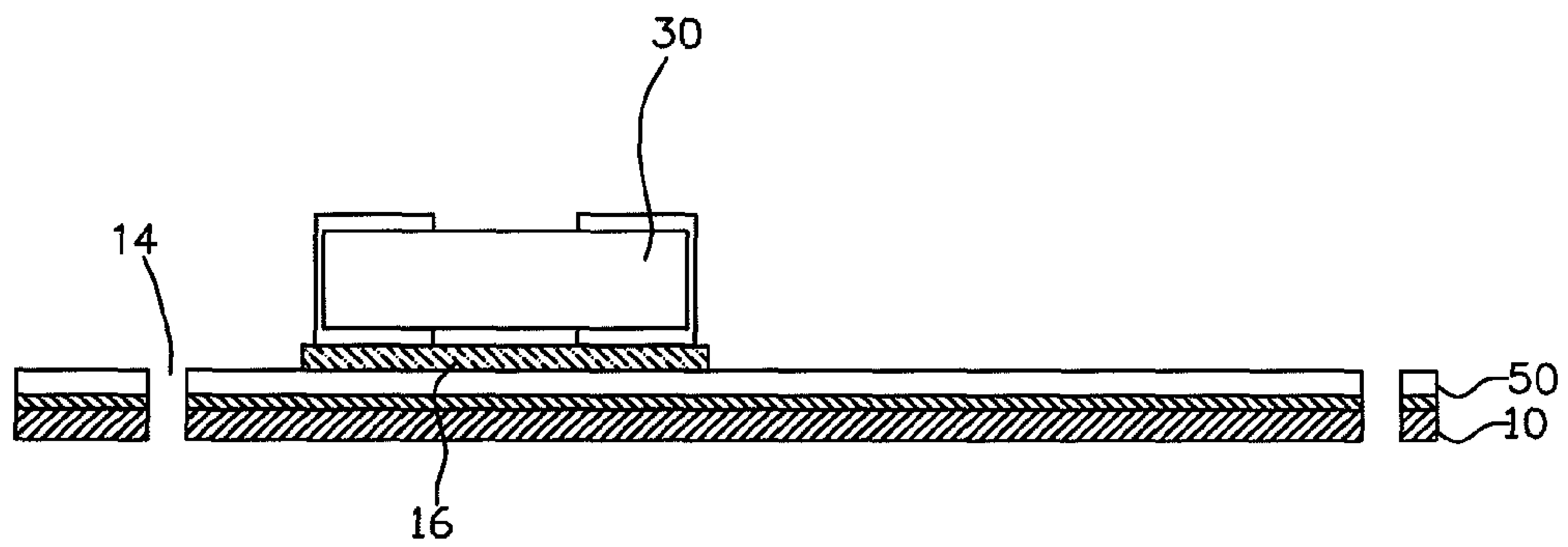


Fig. 3b

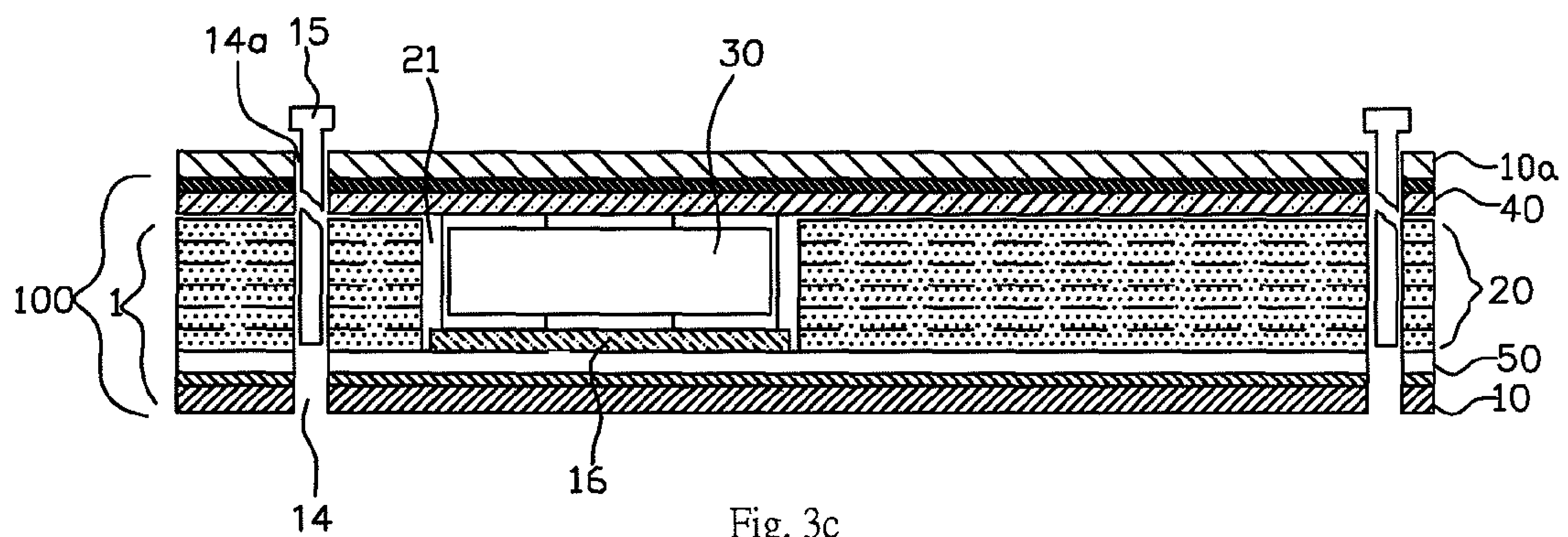


Fig. 3c

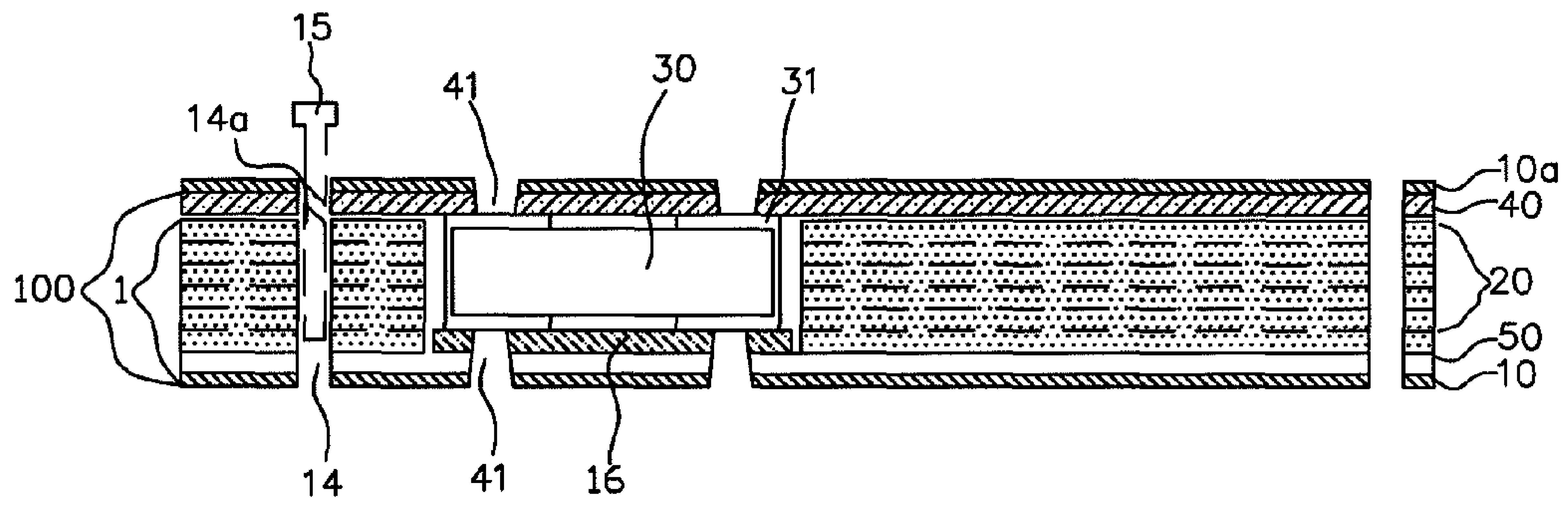


Fig. 3d

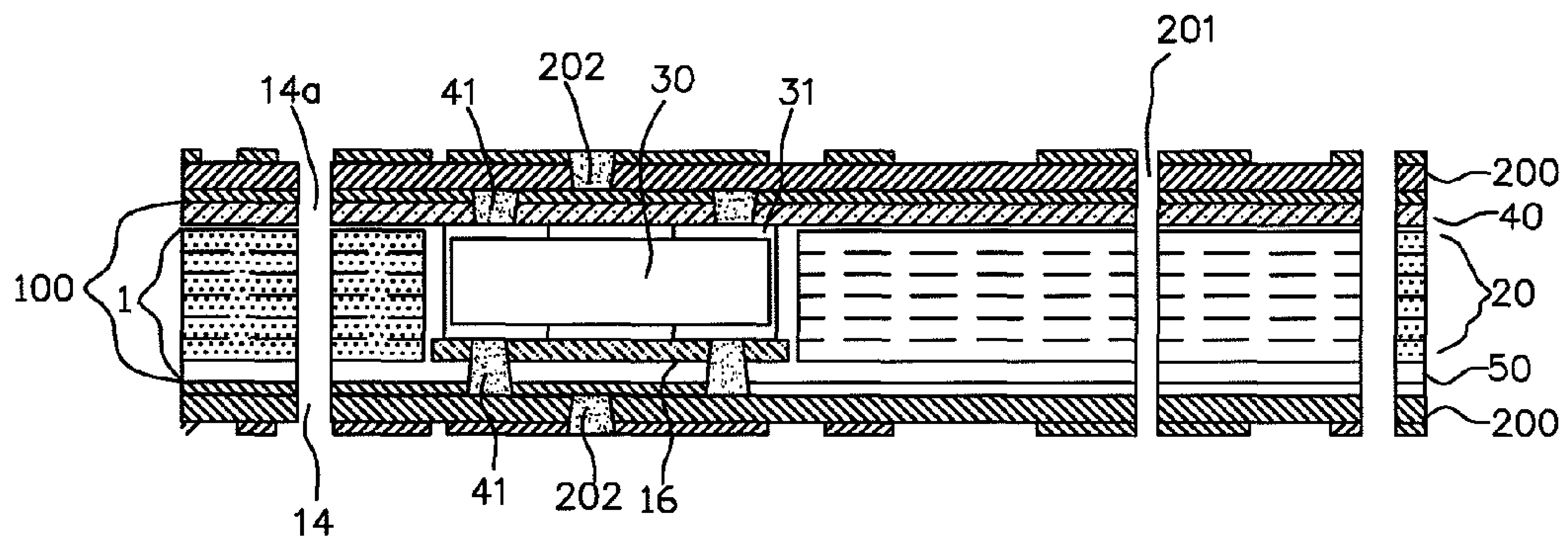


Fig. 3e

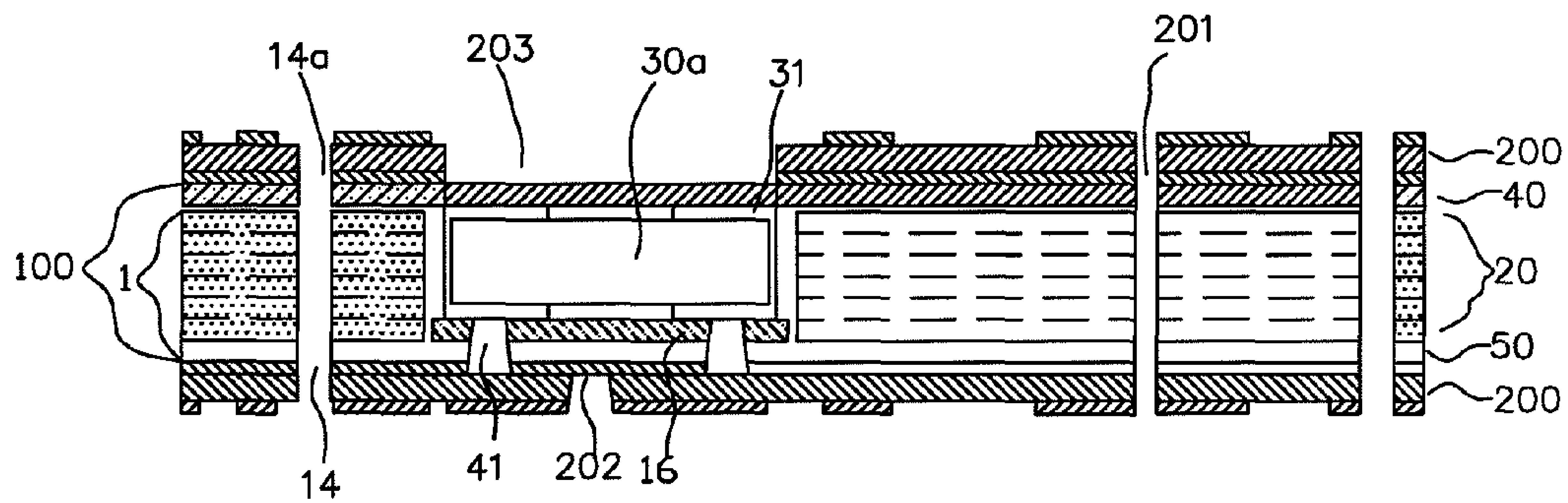


Fig. 3f

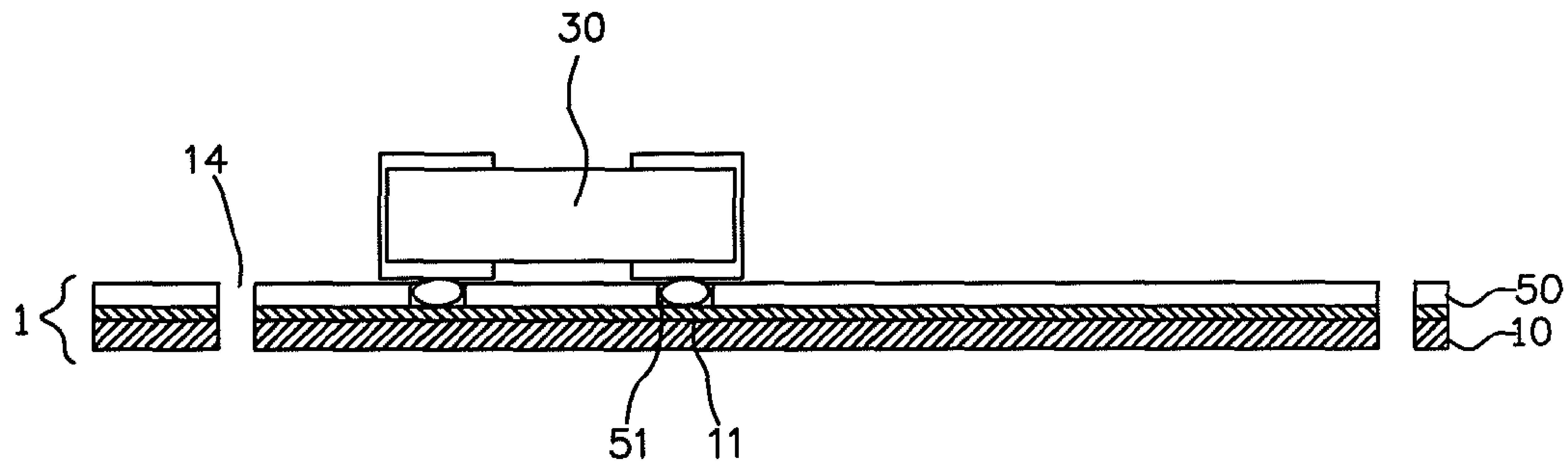


Fig. 4a

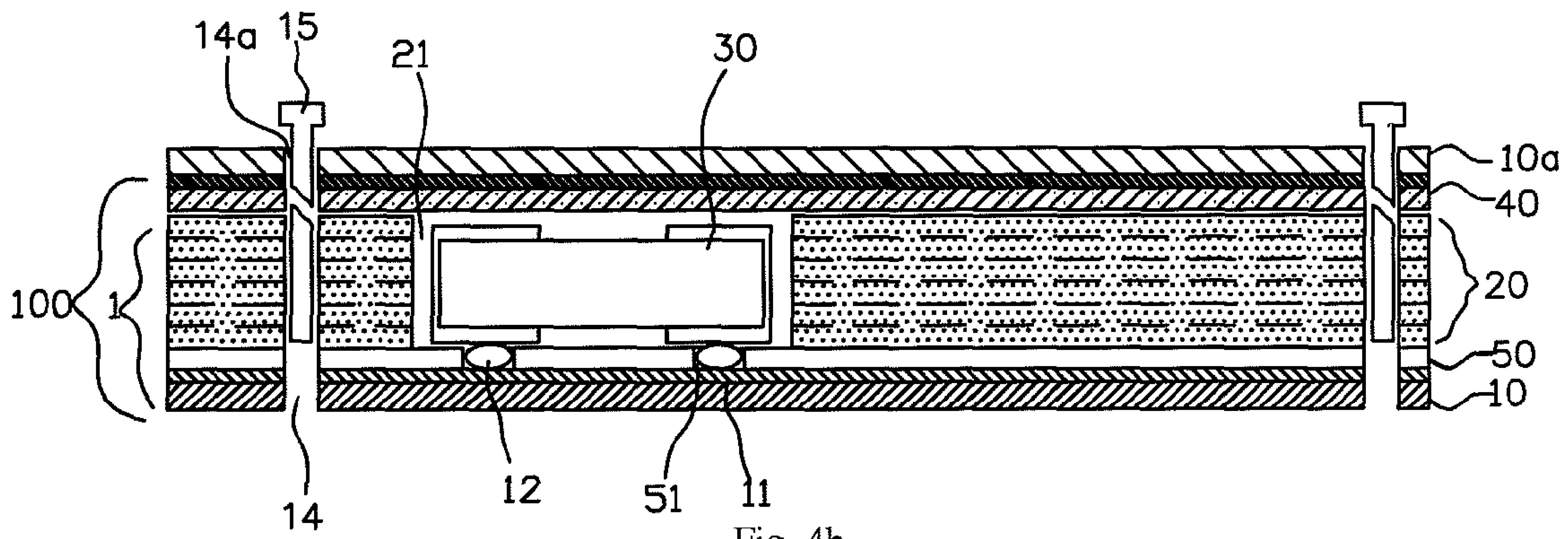


Fig. 4b

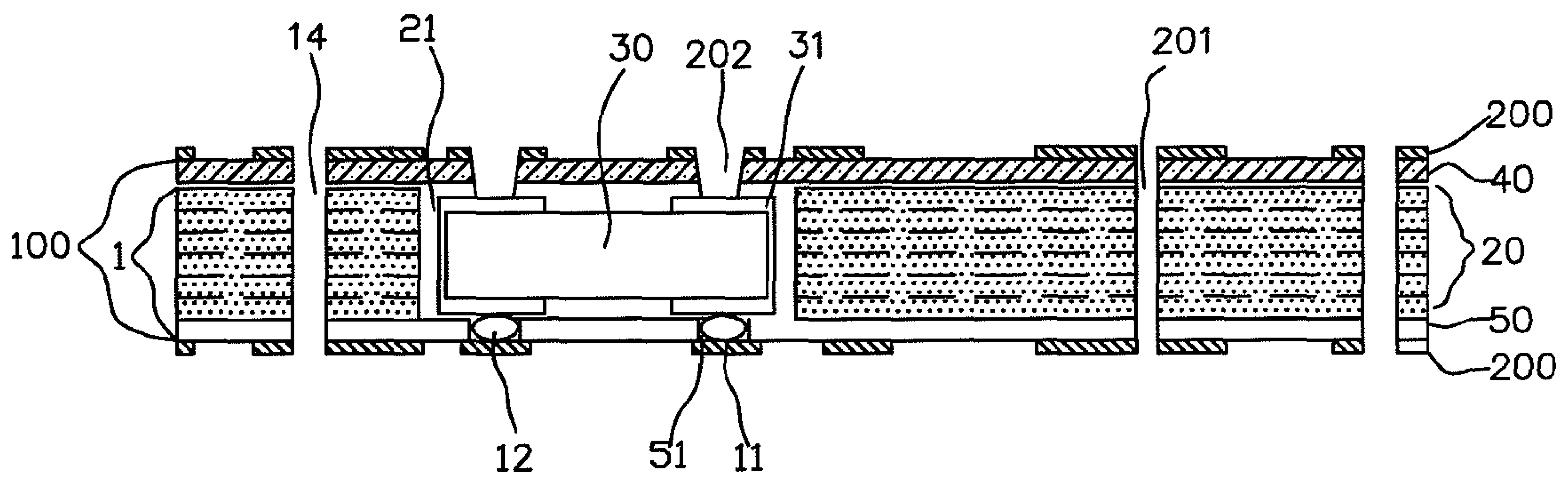


Fig. 4c

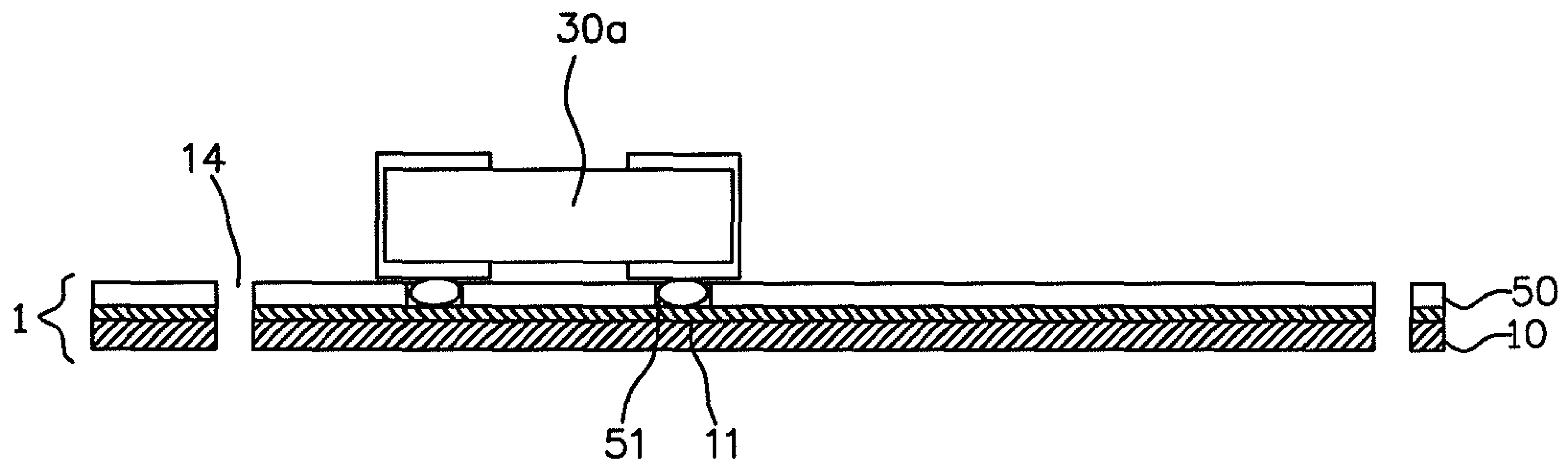


Fig. 5a

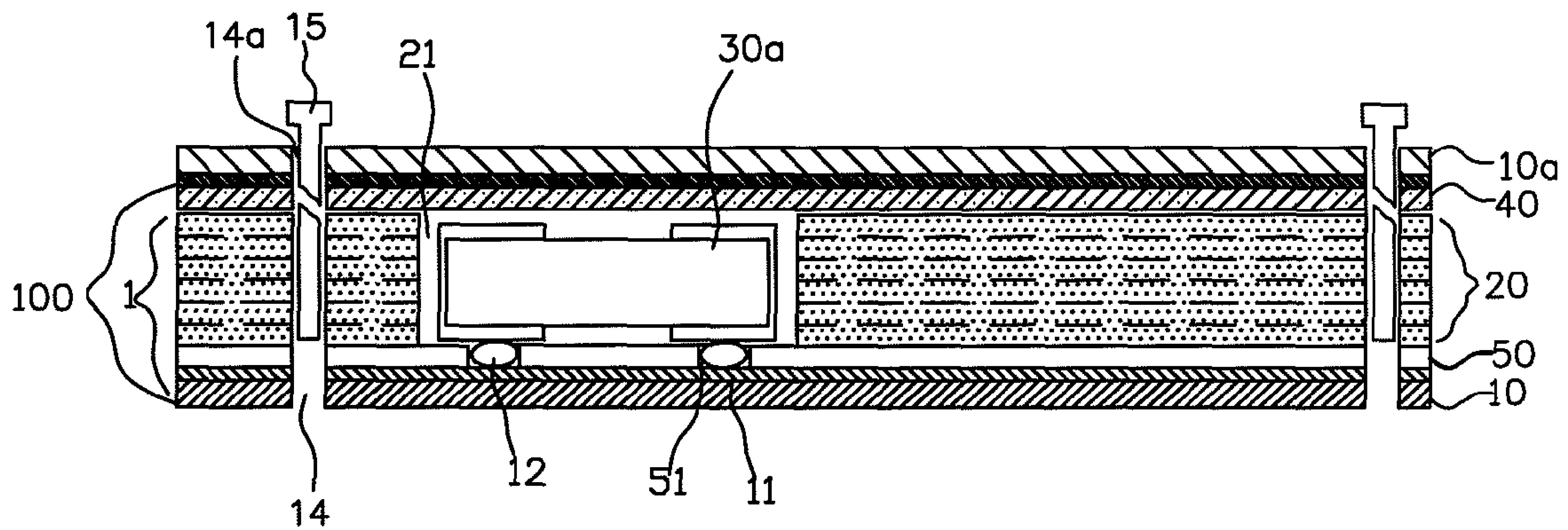


Fig. 5b

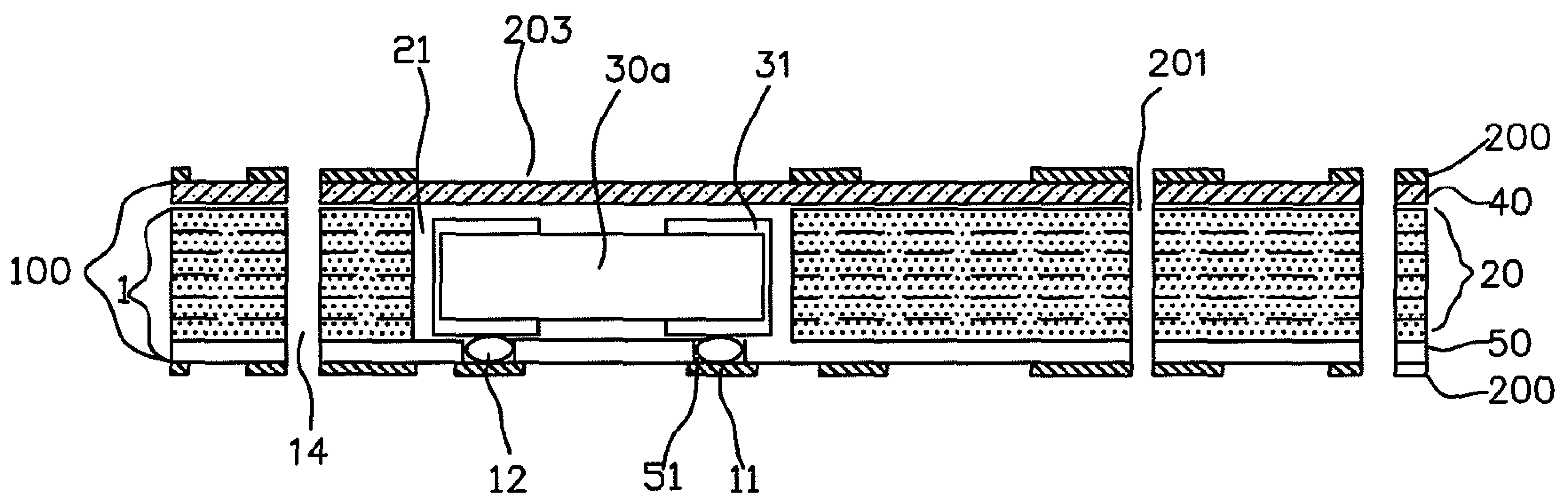


Fig. 5c

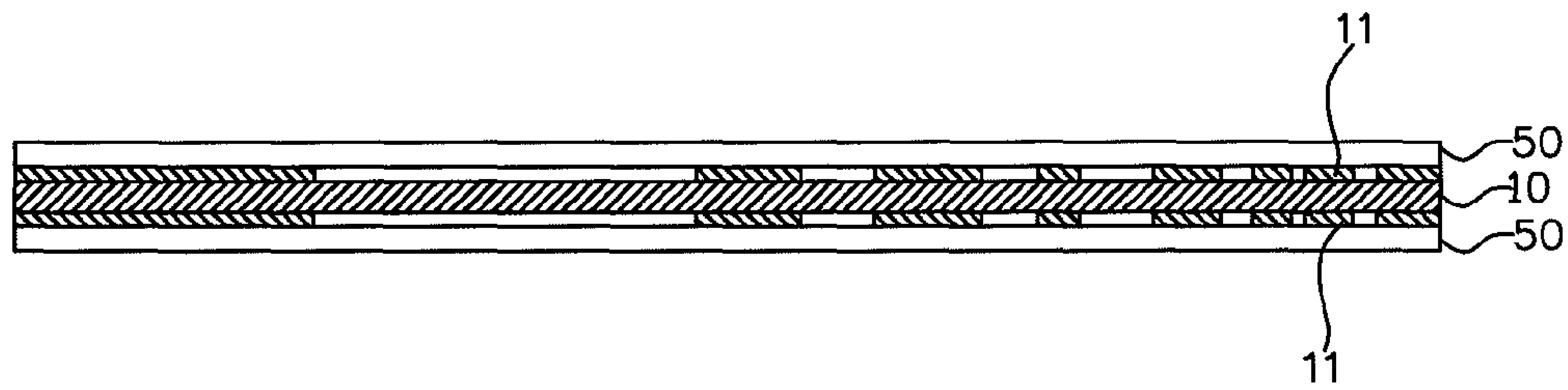


Fig. 6a

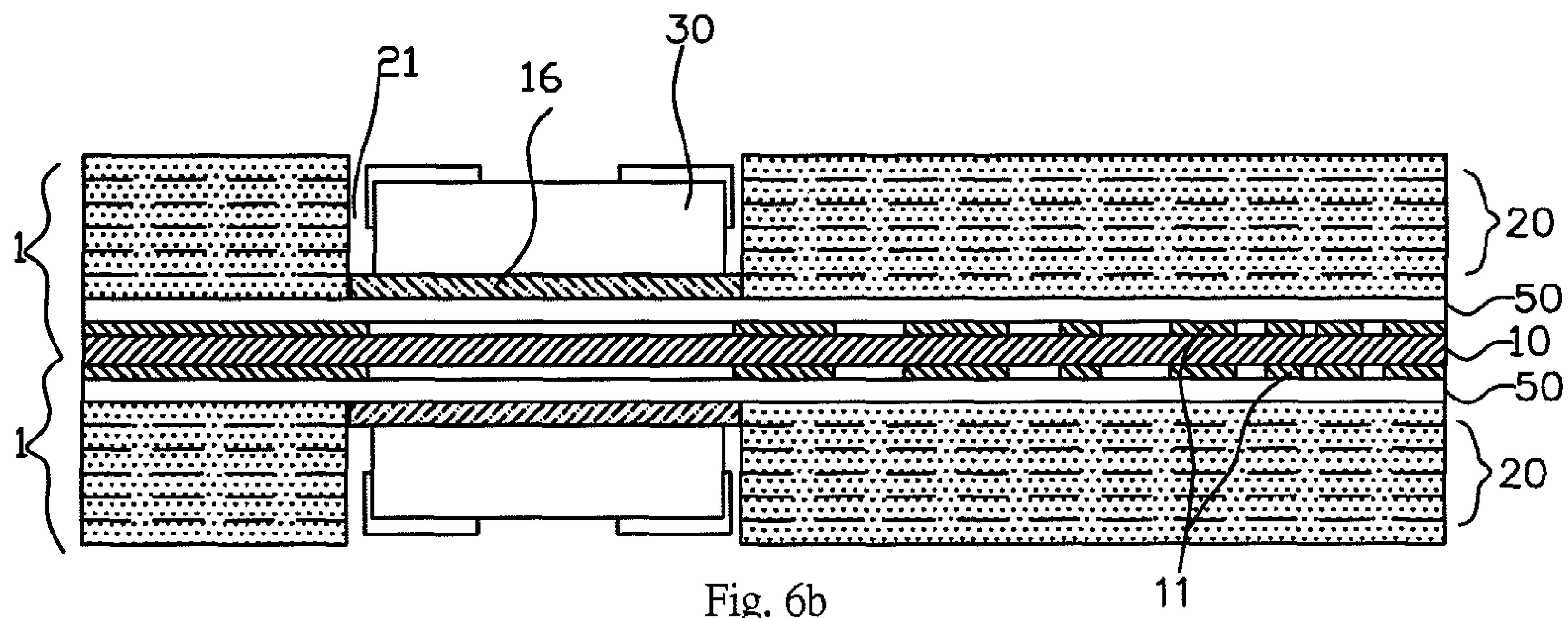


Fig. 6b

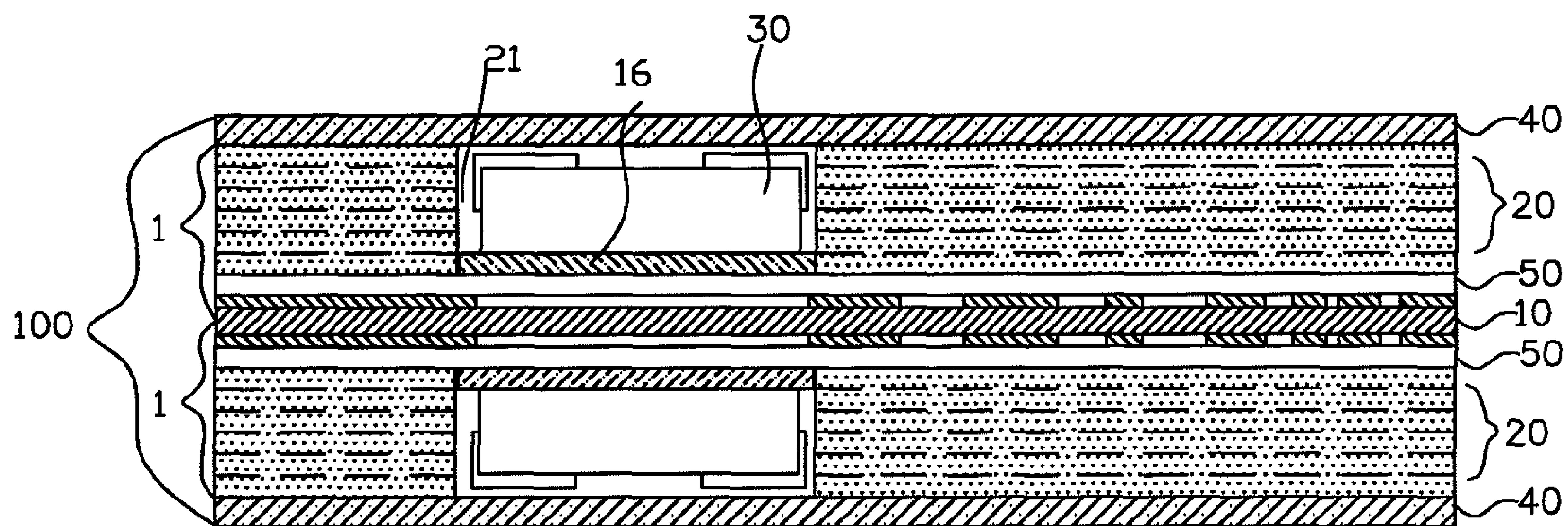


Fig. 6c

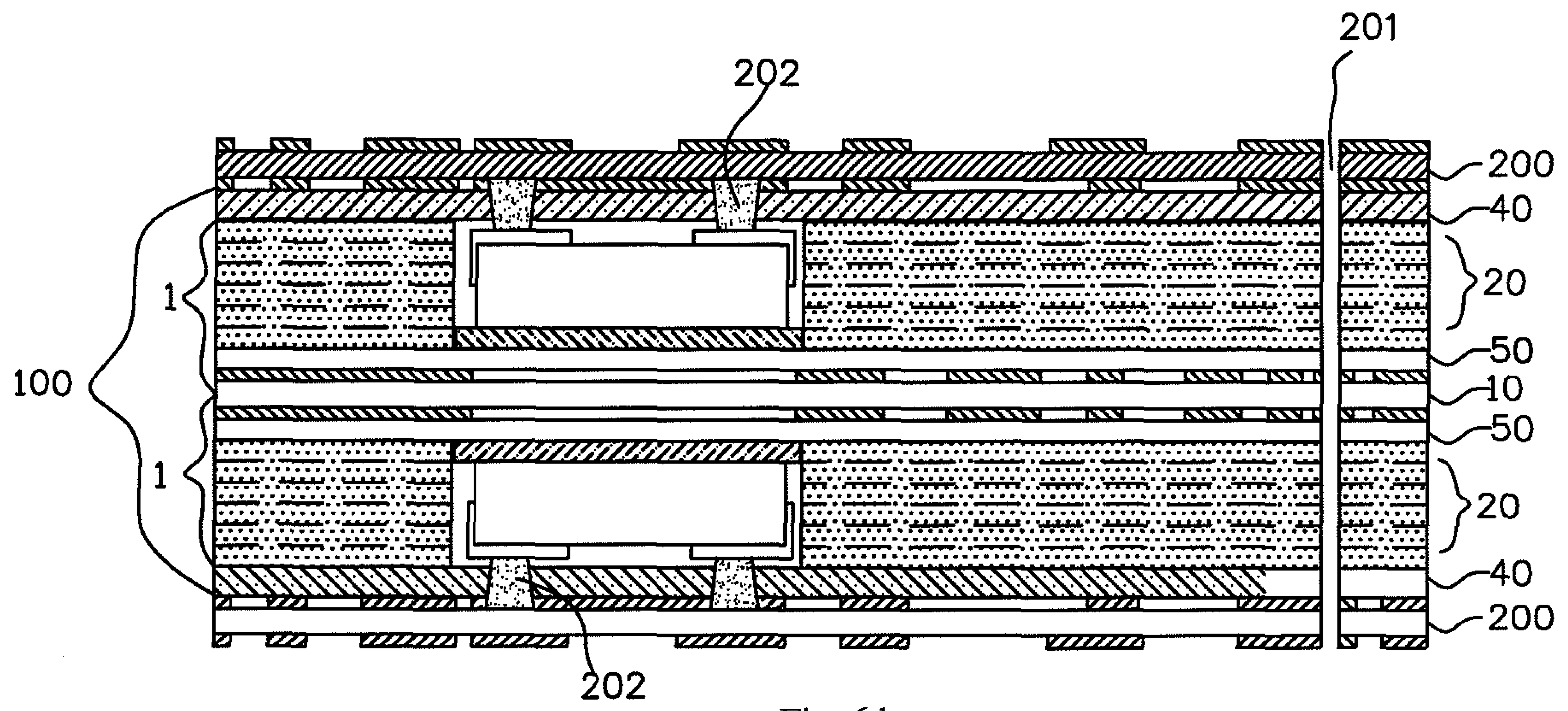


Fig. 6d

METHOD OF MANUFACTURING A MULTILAYER PRINTED CIRCUIT BOARD WITH A BUILT-IN ELECTRONIC DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of manufacturing a multilayer printed circuit board, and more particularly to a method of manufacturing a multilayer printed circuit board with a built-in electronic device.

2. Description of the Related Art

At present, speed and density are two major requirements of the development of high technologies, and it is a primary objective to satisfy consumer requirements as well as lowering the production cost. Thus, electronic and mobile communication products tend to be developed with a light, thin, short and compact design and come with multi-functions, high reliability and low price. These products are generally developed in generations of every three to five years. To comply with this trend, passive components occupying the largest area in a circuit design of electronic products are integrated.

As to a printed circuit board, the area occupied by the electronic devices has been the greatest limitation for miniaturizing the products. With too many soldering points on the printed circuit board, the reliability will be lowered, and the manufacturing cost will be increased. For a better function, a smaller volume and a lighter weight, related manufacturers and designers try to create more spaces and enhance the functions of modules within the area of the baseboard of the printed circuit board. Obviously, integration and embedment are important factors for the development trend of passive electronic devices.

To overcome the aforementioned issues, R.O.C. Pat. No. 518616 disclosed a method of manufacturing a multilayer printed circuit board with embedded passive components, and this method integrates several film electronic devices into a multilayer printed circuit board, and the key measure of the method is the manufacturing capability of embedding thick and thin film electronic devices into the printed circuit board, such that after the electronic device is integrated into the multilayer printed circuit board while maintaining a good electric precision and minimizing the difference between the original design values, the overall manufacturing process will be more complicated.

The foregoing drawbacks are common, and thus manufacturers try to overcome the drawbacks by the following. R.O.C. Pat. No. I246383 disclosed another method of manufacturing a multilayer printed circuit board of embedded passive components, and this method comprises the steps of: providing a conductive foil having at least one pair of metal bumps, and coupling a passive component to the corresponding metal bump; laminating an organic insulating layer onto a core board; laminating the conductive foil onto the organic insulating layer; and forming a circuit pattern on the conductive foil and coupling with the passive component. However, when the conductive foil coupled with the passive component is laminated onto the organic insulating layer, the passive component has a specific height, and there is a risk of damaging the components or affecting the product reliability, since the organic insulating layer will press the components directly during a thermal pressing process.

SUMMARY OF THE INVENTION

In view of the shortcomings of the prior art, the inventor of the present invention based on years of experience in the related industry to conduct extensive researches and experiments, and finally developed a method of manufacturing a multilayer printed circuit board with a built-in electronic device in accordance with the present invention.

Therefore, it is a primary objective of the invention to overcome the shortcomings of the prior art by providing a method of manufacturing a multilayer printed circuit board with a built-in electronic device, and the method can accommodate more electronic devices in the limited space of a copper clad laminate to achieve the effects of enhancing the function and reducing the volume and weight of the printed circuit board, wherein the built-in electronic device is an active component, a passive component or a light emitting element.

Another objective of the present invention is to increase the pressure resistance by a dielectric layer during a later build-up process of circuits, so as to prevent the embedded electronic devices from being damaged by pressing during the manufacturing process.

To achieve the foregoing objectives, the present invention adopts a method comprising the steps of: providing a substrate, wherein the substrate comprises a copper clad laminate and a first dielectric layer; laminating the first dielectric layer onto the copper clad laminate and pre-forming a cavity at a position capable of accommodating an electronic device precisely; laminating a second dielectric layer on the first dielectric layer and the electronic device to complete a base circuit board with an embedded electronic device, wherein the first and second dielectric layers are made of a plastic material; and building up a circuit on the base circuit board and conducting the electronic device with the build-up circuit.

To achieve the foregoing objectives, the present invention adopts another method comprising the steps of: providing a substrate, wherein the substrate comprises a copper clad laminate and a first dielectric layer; laminating the first dielectric layer onto the copper clad laminate, wherein the copper clad laminate has an electric circuit manufactured thereon by lamination, exposure, development, and etching processes; laminating the first dielectric layer onto the copper clad laminate and pre-forming a cavity at a position capable of accommodating an electronic device precisely; laminating a second dielectric layer on the first dielectric layer and the electronic device to complete a base circuit board with an embedded electronic device, wherein the first and second dielectric layers are made of a plastic material; building up a circuit on the base circuit board and conducting the electronic device with the electric circuit of the copper clad laminate or the build-up circuit.

To achieve the foregoing objectives, the present invention adopts a further method comprising the steps of: providing a substrate, wherein the substrate comprises a copper clad laminate and a first dielectric layer; laminating the first dielectric layer onto the copper clad laminate, wherein the copper clad laminate has an electric circuit manufactured thereon by lamination, exposure, development, and etching processes; installing and conducting an electronic device at a specific position on the electric circuit; laminating the first dielectric layer onto the copper clad laminate, and pre-forming a cavity for accommodating the electronic device; laminating a second dielectric layer on the first dielectric layer and the electronic device to complete a base circuit board with embedded electronic devices, wherein the first and second dielectric layers are made of a plastic material; building up a circuit on the base circuit board; and conducting the electronic device with the electric circuit of the copper clad laminate or the build-up circuit.

To achieve the aforementioned objectives, the present invention adopts another method comprising the steps of: coating a protective plastic layer on the copper clad laminate, and forming a window on the protective plastic layer for accommodating an electronic device.

BRIEF DESCRIPTION OF THE DRAWINGS

To make it easier for our examiner to understand the method of the present invention, preferred embodiments together with related drawings are used for the detailed description of the present invention as follows.

FIGS. **1**a~**1**c show a flow chart of the present invention;

FIGS. **2**a~**2**e show a flow chart of a first preferred embodiment of the present invention;

FIGS. **3**a~**3**f show a flow chart of a second preferred embodiment of the present invention;

FIGS. **4**a~**4**c show another flow chart of a second preferred embodiment of the present invention;

FIGS. **5**a~**5**c show a further flow chart of a second preferred embodiment of the present invention; and

FIGS. **6**a~**6**d show a flow chart of a third preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIGS. **1**a~**1**c for a method of manufacturing a multilayer printed circuit board of a built-in electronic device in accordance with the present invention, the manufacturing method comprises the steps of:

providing a substrate **1** as shown in FIG. **1**a, wherein the substrate **1** includes a copper clad laminate **10** and a first dielectric layer **20**;

installing an electronic device **30** on the copper clad laminate **10**;

laminating the first dielectric layer **20** onto the copper clad laminate **10**, and performing a cavity **21** at a position capable of accommodating the electronic device **30** precisely, wherein the first dielectric layer of this preferred embodiment is a sheet body (and the first dielectric layer can be made of laminating single-layer or multilayer sheets);

laminating a second dielectric layer **40** onto the substrate **1** as shown in FIG. **1**b, wherein the second dielectric layer of this preferred embodiment is a sheet body (and the second dielectric layer can be made of laminating single-layer or multilayer sheets), so as to complete a base circuit board **100** with an embedded electronic device;

performing a build-up process for the build-up circuit layer **200** on an external layer (upper/lower layer) of the base circuit board **100** as shown in FIG. **1**c, and conducting the electronic device **30** with the base circuit board **100** or the electronic device **30** with the build-up circuit layer **200** to complete a multilayer printed circuit board with an embedded electronic device.

In the method of manufacturing a multilayer printed circuit board with a built-in electronic device, the copper clad laminate **10** is a copper foil layer, or the copper clad laminate **10** is formed by coating polyimide (PI) or prepreg (PP) onto a copper foil layer, or the copper clad laminate **10** is formed by coating a copper foil layer onto a metal board (such as a copper board or an aluminum board).

Wherein, the copper clad laminate **10** includes an electric circuit manufactured onto the copper foil layer by lamination, exposure, development and etching processes.

Wherein, the electronic device **30** can be an active electronic device or a passive electronic device (such as a resistor, a capacitor, an inductor and a chip) or a light emitting element (such as a light emitting diode).

Wherein, the first and second dielectric layers **20**, **40** are made of a plastic material, such as a combination of prepregs, a dielectric film and a prepreg, or dielectric films with high resin content, so that the plastic material of the first and second dielectric layers **20**, **40** can be filled and stuffed into a gap between the electronic device **30** and the cavity **21** to enhance the fixing strength of the electronic device **30**. Meanwhile, the pressure resistance can be increased during the process of building up the build-up circuit layer **200** to prevent the built-in electronic device **30** from being damaged in the manufacturing process.

With reference to FIGS. **2**a~**2**d for a flow chart of a method of manufacturing a multilayer printed circuit board with a built-in electronic device in accordance with a first preferred embodiment of the present invention, the manufacturing method comprises the steps of:

providing a substrate **1**, wherein the substrate **1** includes a copper clad laminate **10** and a first dielectric layer **20**;

forming an electric circuit **11** on the copper clad laminate **10** by lamination, exposure, development and etching processes as shown in FIG. **2**a, (wherein the copper clad laminate of this preferred embodiment coats polyimide (PI) or prepeg (PP) onto the copper foil layer;

laminating a protective plastic layer **50** on the copper clad laminate **10** (wherein the protective plastic layer of this preferred embodiment can be a film type or a liquid type resin such as an adhesive glue;

forming at least one window **51** at a specific position by a manufacturing technique such as a laser manufacturing after the protective plastic layer **50** is cured, such that the electric circuit **11** is exposed from the window **51**;

installing the electronic device **30** into the cavity **21**, and conducting the electronic device **30** (which can be an active or passive electronic device such as a resistor, a capacitor, an inductor and a chip) with the electric circuit **11** as shown in FIG. **2**b;

laminating a first dielectric layer **20** onto the protective plastic layer **50**, wherein the first dielectric layer **20** has a cavity **21** corresponding to the electronic device **30** and penetrated through the first dielectric layer **20** for sheathing the electronic device **30** to the cavity **21**;

laminating a second dielectric layer **40** onto the substrate **1** to produce a base circuit board **100** with an embedded electronic device;

performing a build-up process to the external layer to form a build-up circuit layer **200** after the base circuit board **100** is produced as shown in FIG. **2**c;

Wherein, the build-up circuit layer **200** can be laminated onto the second dielectric layer **40** after the electric circuit is formed, so that the through hole **201** can be drilled mechanically and provided for performing a chemical electrodeposit copper of the through hole **201** and electroplating the cavity **21** to produce a multilayer printed circuit board with an embedded electronic device;

Alternatively, the build-up circuit layer **200** can be a copper foil layer as shown in FIG. **2**d and the second dielectric layer **40** at the top of the electronic device **30** can be removed by laser to form a micro via **202** and a chemical electrodeposit copper and an electroplating process are performed in the micro via **202** to conduct the electronic device **30** with the build-up circuit layer **200** (and the base circuit board **100** in this preferred embodiment is symmetrically installed), such that a through hole **201** can be drilled mechanically to perform the chemical electrodeposit copper and electroplating process of the through hole **201** to electrically conduct the

basic circuit board **100** and the built-up circuit layer **200** and to produce another type of multilayer printed circuit board with an embedded electronic device.

In the foregoing preferred embodiment, a conditioning process takes place to increase the adhesive force before the protective plastic layer **50** is coated onto a surface of the copper clad laminate **10**.

Wherein, a conductive paste **12** is coated at the conducting position on the electric circuit **11** with the electronic device **30** before the electronic device **30** is installed to the window **51**, such that good binding force and conductivity between the electronic device **30** and the electric circuit **11** can be achieved.

Wherein, the first and second dielectric layers **20**, **40** can be formed by laminating a single layer or a plurality of layers.

Wherein, the first and second dielectric layers **20**, **40** with a plastic property are made of a combination of prepregs, a dielectric film and a prepreg, and dielectric films with high resin content, so that the first and second dielectric layers **20**, **40** with a plastic property can be filled and stuffed into a gap between the electronic devices **30** to increase the fixing strength of the electronic device **30**. Similarly, the pressure resistance can be increased to prevent the embedded electronic device **30** from being damaged by the thermal pressing during the manufacturing process when the build-up circuit layer **200** is added to the second dielectric layer **40**.

Wherein, the electronic device can be a light emitting element **30***a* (or a light emitting diode) as shown in FIG. **2***e*, but the manufacturing methods for the active and passive components are different. When the build-up circuit layer **200** is added to the second dielectric layer **40**, the build-up circuit layer **200** comes with an opening **203** formed at a position opposite to the light emitting element **30***a* for exposing the light emitting element **30***a* without being covered.

Wherein, the second dielectric layer **40** is attached onto the light emitting element **30***a* to prevent the first dielectric layer **20** from being overflowed when the build-up circuit layer **200** is added and laminated.

Wherein, the light emitting element **30***a* and the electric circuit **11** are adhered by a conductive paste **12** (or fixed by a solder) to define an electric conduction.

With reference to FIGS. **3***a*~**3***f* for a flow chart of a method of manufacturing a multilayer printed circuit board with a built-in electronic device in accordance with a second preferred embodiment of the present invention, the manufacturing method comprises the steps of:

providing a substrate **1**, wherein the substrate **1** includes a copper clad laminate **10** and a first dielectric layer **20**;

forming an a copper foil layer onto a metal board (such as a copper board or an aluminum board metal board) of the copper clad laminate **10** as shown in FIG. **3***a*, (wherein the copper clad laminate of this preferred embodiment coats polyimide (PI) or prepeg (PP) onto the copper foil layer);

coating a protective plastic layer **50** (which is made of a film type or a liquid type resin such as an adhesive glue this preferred embodiment) onto the copper clad laminate **10**;

coating an adhesive agent **16** (which is a red glue in this preferred embodiment) at a specific position on the protective plastic layer **50** as shown in FIG. **3***b*, wherein the electronic device **30** can be an active electronic device or a passive electronic device (such as a resistor, a capacitor, an inductor and a chip) or a light emitting element (such as a light emitting diode) installed on the adhesive agent **16**, such that the adhesive agent **16** can be used for fixing the electronic device **30** onto the protective plastic layer **50** of the copper clad laminate **10** securely;

laminating a first dielectric layer **20** onto the protective plastic layer **50**, and forming a cavity **21** penetrated through the first dielectric layer **20** and corresponding to the electronic device **30** and provided for sheathing on the electronic device **30**, wherein the first dielectric layer **20** can be formed by laminating a single or a plurality of layers as shown in FIG. **3***c;*

laminating a second dielectric layer **40** onto the substrate **1** to produce a base circuit board **100** with an embedded electronic device;

laminating a second copper clad laminate **10***a* onto the second dielectric layer **40**, wherein the second copper clad laminate has the same structure as the first copper clad laminate in this preferred embodiment), and the second copper clad laminate has a side of the copper foil layer aligned with and attached onto the second dielectric layer);

performing a lamination process to the base circuit board **100** and the second copper clad laminate **10***a;*

removing the portion of metal boards of the base circuit board **100** and the second copper clad laminate **10***a* after the lamination process takes place as shown in FIG. **3***d;*

using a manufacturing technique (such as a laser manufacturing) to form micro vias **41** on the second dielectric layer **40** and the protective plastic layer **50** and at positions opposite to the electronic device **30** for exposing an electrode terminal **31** of the electronic device **30**;

performing a chemical electrodeposit copper and an electroplating process to the micro vias **41** of the copper foil layers of the copper clad laminate **10** and the second copper clad laminate **10***a*, to manufacture the electric circuit and define an electric conduction of the electronic device **30** with the electric circuits of the first copper clad laminate **10** and the second copper clad laminate **10***a*; and

laminating a build-up circuit layer **200** onto the base circuit board **100**, forming a blind hole **202** on the build-up circuit layer **200**, and performing a chemical electrodeposit copper and an electroplating process as shown in FIG. **3***e*, such that the first copper clad laminate **10** and the second copper clad laminate **10***a* and an electric circuit of the build-up circuit layer **200** are conducted, and then a through hole **201** is drilled mechanically, and a chemical electrodeposit copper and an electroplating of the through hole **201** are performed to electrically conduct the basic circuit board **100** and the built-up circuit layer **200** and to produce a multilayer printed circuit board with an embedded electronic device,

In the foregoing preferred embodiment, a conditioning process takes place to increase the adhesive force of the surfaces before the first copper clad laminate **10** and the second copper clad laminate **10***a* are coated with the protective plastic layer **50**.

Wherein, after the protective plastic layer **50** is cured, a fixing hole **14** is formed and penetrated through the protective plastic layer **50**, and the second copper clad laminate **10***a* includes a fixing hole **14***a* formed at a position opposite to the fixing hole **14** of the copper clad laminate **10**, and the fixing holes **14**, **14***a* are passed and fixed by a fixing element **15** (which is a rivet in this preferred embodiment), and the fixing element **15** can be removed together while the metal boards of the first copper clad laminate **10** and the second copper clad laminate **10***a* are removed.

Wherein, the first and second dielectric layers **20**, **40** are made of a plastic material, such as a combination of prepregs, a dielectric film and a prepreg, or dielectric films with high resin content, so that the plastic material of the first and second dielectric layers **20**, **40** can be filled and stuffed into a gap between the electronic device **30** to enhance the fixing strength of the electronic device **30**. Meanwhile, the pressure

resistance can be increased during the process of building up the build-up circuit layer **200** to prevent the built-in electronic device **30** from being damaged in the manufacturing process.

Wherein, the electronic device can be a light emitting element **30***a* (or a light emitting diode) as shown in FIG. **3***f*, but the manufacturing methods for the active and passive components are different. When the build-up circuit layer **200** is added to the second dielectric layer **40**, the build-up circuit layer **200** comes with an opening **203** formed at a position opposite to the light emitting element **30***a* for exposing the light emitting element **30***a* without being covered.

With reference to FIGS. **4***a*~**4***c* for a second flow chart of a method of manufacturing a multilayer printed circuit board with a built-in electronic device in accordance with a second preferred embodiment of the present invention, the major difference resides on that a substrate **1** having a copper clad laminate **10** and a first dielectric layer **20** is provided.

In FIG. **4***a*, the copper clad laminate **10** has a copper foil layer attached onto a metal board (such as a copper board or an aluminum board).

A protective plastic layer **50** is laminated on the copper clad laminate **10** (wherein the protective plastic layer of this preferred embodiment can be a film type or a liquid type resin such as an adhesive glue).

At least one window **51** is formed at a specific position by a manufacturing technique such as a laser manufacturing after the protective plastic layer **50** is cured, such that the electric circuit **11** is exposed from the window **51**.

A protective plastic layer **50** is coated onto the copper clad laminate **10**, and after the protective plastic layer **50** is cured, at least one window **51** is formed at a specific position by a manufacturing technique (such as a laser manufacturing process) for exposing a specific position of the electric circuit **11**, and then a metal terminal of the electronic device **30** is installed into the window **51** to conduct the electronic device **30** with the electric circuit **11**.

In FIG. **4***b*, a first dielectric layer **20** is laminated onto the protective plastic layer **50**, and the first dielectric layer **20** has a cavity **21** penetrated through the first dielectric layer **20** and corresponding to the electronic device **30**, such that the cavity **21** can be sheathed on the electronic device **30**. A second dielectric layer **40** is laminated onto the substrate **1** to produce a base circuit board **100** with an embedded electronic device.

A second copper clad laminate **10***a* (which has the same structure of the first copper clad laminate in this preferred embodiment, and the second copper clad laminate has a side of the copper foil layer facing and being attached onto the second dielectric layer) onto the second dielectric layer **40**.

The base circuit board **100** and the second copper clad laminate **10***a* are laminated.

In FIG. **4***c*, the metal boards of the base circuit board **100** and second copper clad laminate **10***a* are removed, after the lamination process takes place.

A build-up circuit layer **200** is added to copper foil layers of the first copper clad laminate **10** and the second copper clad laminate **10***a*, and a micro via **202** is formed separately on the second copper clad laminate **10***a* and the build-up circuit layer **200**, and a chemical electrodeposit copper and an electroplating process are performed, such that the electric circuits of the second copper clad laminate **10***a* and the build-up circuit layer **200** are conducted.

A through hole **201** is drilled mechanically, and a chemical electrodeposit copper and an electroplating of the through hole **201** are performed to electrically conduct the basic circuit board **100** and the built-up circuit layer **200** and to produce a multilayer printed circuit board with an embedded electronic device.

Wherein, the second dielectric layer **40** is attached onto the light emitting element **30***a* for preventing the overflow of the first dielectric layer **20** when the build-up circuit layer **200** is added.

Wherein, the electronic device **30** and the electric circuit **11** are adhered by a conductive paste **12** (or fixed by a solder) to define an electric conduction.

With reference to FIGS. **5***a*~**5***c* for a chart of a method of manufacturing a multilayer printed circuit board with a built-in electronic device in accordance with a third preferred embodiment of the present invention, the major difference resides on that a substrate **1** having a copper clad laminate **10** and a first dielectric layer **20** is provided.

In FIG. **5***a*, the copper clad laminate **10** has a copper foil layer attached onto a metal board (which is a copper board or an aluminum board).

A protective plastic layer **50** is laminated on the copper clad laminate **10** (wherein the protective plastic layer of this preferred embodiment can be a film type or a liquid type resin such as an adhesive glue).

At least one window **51** is formed at a specific position by a manufacturing technique such as a laser manufacturing after the protective plastic layer **50** is cured, such that the electric circuit **11** is exposed from the window **51**.

A protective plastic layer **50** is coated onto the copper clad laminate **10**, and after the protective plastic layer **50** is cured, at least one window **51** is formed at a specific position by a manufacturing technique (such as a laser manufacturing process) for exposing a specific position of the electric circuit **11**, and then a metal terminal of the electronic device **30** is installed into the window **51** to conduct the electronic device **30** with the electric circuit **11**.

In FIG. **5***b*, a first dielectric layer **20** is laminated onto the protective plastic layer **50**, and the first dielectric layer **20** has a cavity **21** penetrated through the first dielectric layer **20** and corresponding to the light emitting element **30***a*, such that the cavity **21** can be sheathed on the light emitting element **30***a*. A second dielectric layer **40** is laminated onto the substrate **1** to produce a base circuit board **100** with an embedded electronic device.

A second copper clad laminate **10***a* (which has the same structure of the first copper clad laminate in this preferred embodiment, and the second copper clad laminate has a side of the copper foil layer facing and being attached onto the second dielectric layer) onto the second dielectric layer **40**.

The base circuit board **100** and the second copper clad laminate **10***a* are laminated.

In FIG. **5**, after the lamination process takes place, the metal boards of the base circuit board **100** and the second copper clad laminate **10***a* are removed. A build-up circuit layer **200** is added to copper foil layers of the first copper clad laminate **10** and the second copper clad laminate **10***a*, and a through hole **201** is formed, and a chemical electrodeposit copper and an electroplating process are performed to produce a multilayer printed circuit board with an embedded light emitting element.

Similarly, when the build-up circuit layer **200** is formed on the second dielectric layer **40**, the build-up circuit layer **200** comes with an opening **203** formed at a position opposite to the light emitting element **30***a* for exposing the light emitting element **30***a* without being covered.

Wherein, the second dielectric layer **40** is attached onto the light emitting element **30***a* for preventing the overflow of the first dielectric layer **20** when the build-up circuit layer **200** is added.

Wherein, the light emitting element **30***a* and the electric circuit **11** are adhered by a conductive paste **12** (or fixed by a solder) to define an electric conduction.

With reference to FIGS. **6***a*~**6***d* for a flow chart of a method of manufacturing a multilayer printed circuit board with a built-in electronic device in accordance with a third preferred embodiment of the present invention, the manufacturing method comprises the steps of:

providing a substrate **1**, wherein the substrate **1** includes a copper clad laminate **10** and a first dielectric layer **20**;

forming an electric circuit **11** on the copper clad laminate **10** by lamination, exposure, development and etching processes as shown in FIG. **6***a*, (wherein the copper clad laminate of this preferred embodiment coats polyimide (PI) or prepeg (PP) onto the copper foil layer;

coating a protective plastic layer **50** onto the copper clad laminate **10** (wherein the protective plastic layer of this preferred embodiment can be made of a film type or a liquid type resin such as an adhesive glue), and coating an adhesive agent **16** (which is a red glue in this preferred embodiment) at a specific position after the protective plastic layer **50** is cured, wherein the electronic device **30** can be an active electronic device or a passive electronic device (such as a resistor, a capacitor, an inductor and a chip) or a light emitting element (such as a light emitting diode) installed on the adhesive agent **16**, such that the adhesive agent **16** can be used for fixing the electronic device **30** onto the protective plastic layer **50** of the copper clad laminate **10** securely;

laminating a first dielectric layer **20** on the protective plastic layer **50**, and forming a cavity **21** penetrated through the first dielectric layer **20** and corresponding to the electronic device **30**, such that the cavity **21** can be sheathed on the electronic device **30** as shown in FIG. **6***b*, wherein the first dielectric layer **20** can be formed by laminating a plurality of layers;

laminating a second dielectric layer **40** on the substrate **1** to produce a base circuit board **100** with an embedded electronic device as shown in FIG. **6***c*, wherein the second dielectric layer **40** can be made of laminating a plurality of layers;

laminating a build-up circuit layer **200** (which is a copper foil layer in this preferred embodiment) onto the second dielectric layer **40** after the base circuit board **100** is produced, and then using laser to remove the second dielectric layer **40** at the top of the electronic device **30** to form a micro via **202** and performing a chemical electrodeposit copper and an electroplating process to the micro via **202** to conduct the electronic device **30** with the build-up circuit layer **200** as shown in FIG. **6***d*; and

drilling a through hole **201** mechanically, and performing the chemical electrodeposit copper and electroplating process of the through hole **201** to electrically conduct the basic circuit board **100** and the built-up circuit layer **200** and to produce a multilayer printed circuit board with an embedded electronic device;

In the foregoing preferred embodiment, a conditioning process takes place to increase the adhesive force before the protective plastic layer **50** is coated onto a surface of the copper clad laminate **10**.

Wherein, the first and second dielectric layers **20**, **40** are made of a plastic material, such as a combination of prepregs, a dielectric film and a prepreg, or dielectric films with high resin content, so that the plastic material of the first and second dielectric layers **20**, **40** can be filled and stuffed into a gap between the electronic device **30** and the cavity **21** to enhance the fixing strength of the electronic device **30**. Meanwhile, the pressure resistance can be increased during the process of building up the build-up circuit layer onto the second dielectric layer **40** to prevent the built-in electronic device **30** from being damaged in the manufacturing process.

Obviously, the present invention can improve over the prior art and comply with the patent application requirements, and thus the invention is duly filed for patent application. While the invention has been described by device of specific embodiments, numerous modifications and variations could be made thereto by those generally skilled in the art without departing from the scope and spirit of the invention set forth in the claims.

What is claimed is:

1. A method of manufacturing a multilayer printed circuit board of a built-in electronic device, comprising the steps of;

providing a substrate, and the substrate including a copper clad laminate with a metal board and a copper foil layer coated onto the metal board;

laminating a first dielectric layer with a plastic property onto the copper clad laminate, and the first dielectric layer formed by laminating a plurality of layers, and having a cavity penetrated through the first dielectric layer;

installing the electronic device into the cavity and laminating a second dielectric layer with a plastic property onto the substrate and the electronic device to produce a base circuit board; and

forming an electric circuit on the base circuit board;

wherein the second dielectric layer sequentially comprises a second copper clad laminate laminated thereon and having a metal board and a copper foil layer, and the copper foil layer is coated on the metal board, and after the copper clad laminate and the second copper clad laminate are attached closely by a lamination process, the metal boards are removed.

2. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, wherein after the metal boards are removed, an electric circuit layer is formed on the copper foil layer.

3. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, wherein before the copper clad laminate and the second copper clad laminate are attached closely, a fixing hole is formed and penetrated separately through corresponding positions of the first copper clad laminate and the second copper clad laminate, and a fixing element is passed through the fixing holes for fixing the first and second copper clad laminates.

4. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, wherein the copper clad laminate is coated with a protective plastic layer.

5. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **4**, wherein the protective plastic layer is made of film type or liquid type resin.

6. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **5**, wherein the protective plastic layer is coated with an adhesive agent at a contact position with the electronic device to fix the electronic device onto the protective plastic layer securely.

7. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, wherein the adhesive agent is a non-conductive adhesive.

8. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **5**, wherein the protective plastic layer or the second dielectric layer has a micro via formed at a position opposite to the

electronic device and provided for exposing an electrode terminal of the electronic device to manufacture the electric circuit and perform a chemical electrodeposit copper and an electroplating process of the micro vias.

9. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, further conducting the electronic devices by a solder or a conductive paste.

10. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, wherein the electronic device is an active electronic device and a passive electronic device.

11. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **10**, wherein the electronic device is a light emitting element or a light emitting diode.

12. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **11**, wherein the build-up circuit layer has an opening formed at a position opposite to the light emitting element when the build-up circuit layer is formed on the second dielectric layer, such that the light emitting element is exposed without being covered.

13. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, wherein the build-up circuit layer includes a through hole mechanically drilled through the build-up layer for performing a chemical electrodeposit copper of the through hole and electroplating the through hole to electrically conduct the basic circuit board and the build-up circuit layer.

14. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, wherein the metal board of the copper clad laminate is a copper board or an aluminum board.

15. The method of manufacturing a multilayer printed circuit board of a built-in electronic device according to in claim **1**, wherein the metal board of the second copper clad laminate is a copper board or an aluminum board.

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